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ABSTRACT

This unit, designed for intermediate grades of elementary schools, focuses on the living forest by presenting such concepts as succession, forest communities, adaptation, ecological interrelationships, animal populations, the impact of man on forests, and job opportunities in the forest industry. The unit includes the behavioral objectives and the expected student criteria for evaluation, pretests and posttests, suggested methodologies for teaching each concept, relevant background information, suggested student data sheets, and a bibliography of both student and teacher resources. (MLB)

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ENVIRONMENTAL ECOLOGICAL EDUCATION PROJECT

Parkway School District
Chesterfield, Missouri

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Unit: The Living Forest

Revised June 1972

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SE 018 229

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SETTING

The setting for this unit could be the intermediate grades of any elementary school within the Parkway School District with access to a woods. Concepts concerning ponds and streams have also been included for those schools with access to such features. Because woods outcrop throughout much of the Midwest, this unit is based on numerous real-life environmental resources: plant, animal, man-made, and otherwise.

The instructional program of this unit is divided into parts which promote the use of area and school-site resources. The units are written behaviorally in order to maximize the efficiency with which students achieve specified objectives.

CONCEPTS

I. A forest or wooded area has particular characteristics due to non-living (abiotic) factors present.

II. A forest develops through a process called succession.

III. In any climax forest, the major plant species continue to replace themselves instead of being replaced by a new community.

IV. Forest communities, including animal populations, are dominated, or controlled, by the plant species present.

V. Any natural community is made up of interrelationships between all plants and animals within it.

VI. Color and sound play an important role in the forest.

VII. The forest is affected by man's values.

VIII. The forest provides jobs for man.

BFHAVIORAL OBJFCTIVES

Upon completion of the unit dealing with the forest:

Concept Number

I. 1. Fighty percent of the students will be able to write in two to five sentences how one abiotic factor, soil, temperature, sunlight or moisture affects the characteristics of a forest community.

II. 2. From a given list eighty percent of the students will be able to arrange in order the steps of succession in the following situation:
In the past a pioneer cleared a section of a forest for cultivation; later the field was abandoned for a period of 30 or 40 years.

III. 3. Sixty percent of the students will be able to correctly respond "true" or "false" to the following statement:
In a forest, once a stable (climax) condition is reached, the major plant species continue to replace themselves instead of being replaced by a new community.

IV. 4. Sixty percent of the students will be able to make the correct response from a given list to the following situation:
Suppose a disease attacks the oak trees and there are very few acorns produced. The diet of squirrels is almost entirely composed of acorns. What possible effect would this have on the squirrel community?

V. 5. Seventy-five percent of the students will be able to construct a food chain from a given list starting with the producer.

V. 6. Sixty percent of the students will be able, given a list of choices, to differentiate between those examples which demonstrate cooperation and those which illustrate competition.

VI. 7. Fifty percent of the students will be able to list two examples of what an animal is communicating when it produces sounds.

VI. 8. Fighty percent of the students will be able to identify those animals who use their coloring as a means of protection from a given list.

VII. 9. Seventy-five percent of the students will be able to explain in writing, using 25 words or more, what the forest means to them and to their future.

VII. 10. Eighty percent of the students will be able to list three occupations provided by the forest.

PRE-POST TEST

BEHAVIORAL OBJECTIVE NUMBER

Name _____ THE LIVING FOREST

1. 1. Select one of the abiotic factors listed below and tell in two to five sentences how this factor affects a forest community. (1) Soil, (2) moisture, (3) temperature, (4) sunlight.

_____

_____

_____

_____

_____

2. 2. Number in order the steps of succession in the following situation:
In the past a pioneer cleared a section of forest for cultivation; later the field was abandoned for a period of 30 to 40 years.

_____sassafras and cottonwood trees

_____grasses and herbs

_____oak and hickory trees

3. 3. (True, False) Circle the correct response. In a forest, once a stable (climax) condition is reached, the major plant species continue to replace themselves instead of being replaced by a new community.

4. 4. Suppose a disease attacks the oak trees and there are very few acorns produced. The diet of squirrels is almost entirely composed of acorns. What possible effect would this have on the squirrel community? (Circle the correct letter)

(a) No effect; because animals use many food sources and food is always plentiful in the forest comminity.

(b) All the squirrels would die because their entire food supply was gone.

(c) All animals in the forest community would suffer because the remaining food sources would probably be over-used.

(d) The squirrels would migrate to an area where there was a sufficient supply of acorns.

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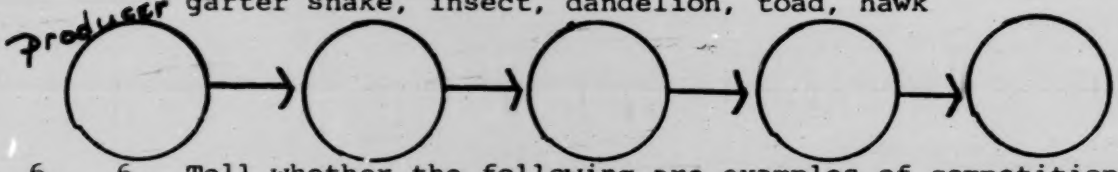
5. 5. Arrange the following plants and animals into a food chain beginning with the producer:
garter snake, insect, dandelion, toad, hawk



6. 6. Tell whether the following are examples of <u>competition</u> or <u>cooperation</u>.

_____a. birds establishing territorial rights
_____b. insects pollinating flowers
_____c. large oaks providing shade for oak seedlings
_____d. large oaks providing shade for dogwood
_____e. ants milking aphids

7. 7. Sound is a form of communication among the animals in a forest. List two things an animal communicates when it produces sound.

a. _____

b. _____

8. 8. In the following list, which response is an illustration of an animal using coloring for protection?

(a) walking stick
(b) deer
(c) field mouse
(d) all of these
(e) none of these

9. 9. In 25 words or more, explain what the forest means to you and to your future. _____

_____

_____

_____

_____

10. 10. List three occupations provided by the forest:

a. _____

b. _____

c. _____

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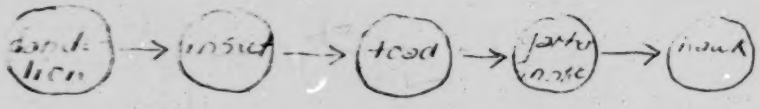
PRE-POST TEST ANSWERS

1. Answers will vary.

2. (1) grasses and herbs, (2) sassafras and cottonwood trees, (3) oak and hickory trees

3. True

4. (d)

5. 

6. a. competition
   b. cooperation
   c. cooperation
   d. competition
   e. cooperation

7. warning of danger, establishing territories, contentment, hunger in young, mating, etc.
   Note: This question does <u>not</u> refer to the sounds produced like "chirp" or "bark".

8. (d)

9. Answers will vary.

10. Answers will vary.

Behavioral Objective Number

BACKGROUND INFORMATION

1. In a temperate area, where seasons change from summer heat to winter cold and where there is sufficient moisture, the natural ground cover is forest - and a forest of a particular kind. These conditions favor the growth of deciduous trees, named for their habit of shedding their leaves in the fall.

Water is essential for life as we know it. All organisms, whether they are made up of one or many cells, contain water in the protoplasm of their cells. All organisms must have water in order to carry on the processes of life. The water these organisms must have is obtained from their environment.

The requirements various organisms have for water are not all the same. Those requiring relatively great amounts of water are not found where the water supply is limited. For each type of organism, then, there is a minimum and a maximum amount of water with which the organism can exist. The amount represents the limits of tolerance of the organism for the water factor in its environment. The same organisms also have a range of tolerance for light, air, soil, and temperature (abiotic factors). Thus the presence and success of an organism in a given region depend upon a complex set of conditions.

Deciduous forest require adequate moisture and temperatures that are not too low. In the temperate zones, the average annual precipitation may approximately be 40 inches. Cold winters and warm summers develop regional communities in which maple, beech, and other deciduous trees dominate. A deciduous forest commonly includes two or more species, as in the beech-maple, oak-hickory, elm-ash-maple, or willow-cottonwood-sycamore communities. Changes in weather are characteristic in such regions. In winter snow may be heavy, but it often melts rapidly and the ground is seldom snow-covered throughout the season. In summer heat and humidity may both be high; but at any time cool, dry masses of air may push down from higher latitudes.

. & 3. A climax forest is reached only through a series of many steps called succession. In order to understand climax it is necessary to go through the steps of succession.

During each of the successive states through which a community passes, there is change in most, if not all, of the organisms that compose it. New plants and animals appear over a period of time. They bring about changes in the environment which actually serve to make living conditions less hospitable for them. For example, a lichen can colonize bare rock; but once it has done so, it has created small amounts of soil in which mosses flourish, forcing out the lichens. The mosses, in turn, create even more soil due to the fact that they have water-holding ability. They create conditions favorable to the growth of small seed plants, with which the mosses can no longer compete. These, in turn, shelter the seedlings of shrubs and trees, which eventually overtop the seed plants and deprive them of sunlight and root space. This process of continual development gradually slows down until a period of equilibrium is reached, known as the climax.

Abandoned corn fields provide many visible examples of succession. Originally these areas were covered with hardwood forests. They were cut down by settlers to make room for agriculture. However, in modern times, it is not profitable to continue farming in some areas. As the agricultural fields are abandoned, nature slowly takes over. Weeds, grasses, herbs, shrubs, and eventually trees return. There is a continuous succession of dominant species, such as, the oak-hickory.

The climax community is reached when a canopy layer (the tallest trees) produces a covering of leaves and dense shade. No other kind of tree can survive long enough to become one of the dominant trees. For this reason the dogwood cannot survive in the dense shade of the large oak. Climax tree seedlings must be able to grow in the dense shade of the climax forest. Large oaks provide shade for oak seedlings.

The amount of radiation the soil receives from direct sunlight varies with the seasons. If the radiation is cut off by leaves, plants that need a larger amount of the sun's light do not survive. Scientists say they are not shade tolerant; that is, they cannot grow in shade. Climax is distinguished by the fact that is reproduces itself; the conditions it creates are stable only for the offspring of its own kind. This climax forest community, once it is formed, may then persist for tens of thousands of years as long as the climate of the region does not change or some catastrophe strikes the area.

One of the miracles of life on earth is the cycle that begins with the green plants, which use energy from the sun, combine it with water and carbon dioxide to create food, and in turn release oxygen into the atmosphere. Man and other animals are the beneficiaries of this process. Animal life consumes the plants, making use of the energy stored within them, and breathes the oxygen that was released by the green plants.

The forest community is a fantastic complex of organisms that live together in the same environment, all of them dependent upon interacting with the others in some fashion.

5. While many organisms share the same habitat, their life styles are different. In a forest of tall trees, little sunlight filters down to the forest floor. Mosses, mushrooms, worms, insects, and forest mammals can be found on this dark, cool floor. Higher up, the branches of the trees make good nesting places for birds. Each of the species has a special place to live and a special way of life. Some plants are food producers while others are saprophytes. Some animals eat plants and some are predators which feed upon other animals.

These interactions determine the niche. A niche is not just a place to live but it is also a way of life. It is not surprising that each organism seeks a niche that is not competitive. If the niche is too competitive, the organism may not long survive. Some environmental necessities, such as air, water, and soil are so plentiful that usually no competition for them results. But if one essential is in short supply, competition will weed out the weaker species. Animals usually compete for water, food, or nesting places.

The welfare of each species is influenced by other species living within the same community. Just as the abiotic factors of sunlight, soil, temperature, and moisture determine the plant community, the plant community, in turn, controls and determines the animal community.

One of the most important fruits of the forest, in terms of what it yields to the forest community, is the fruit of the oak - the acorn. Acorns are rich in carbohydrates, fats, and vitamins and are the staple items in the diet of many insects, animals, and birds. In poor years, when the acorn crop is lean, the situation can be critical for the forest inhabitants. Animals such as squirrels depend upon the acorn crop for winter storage. If the number of acorns is meager and cannot support the squirrel population, it will migrate out of the area into an area where the crop is more plentiful.

It is the green plant, with its ability to convert sunlight into food, that is the producer, the first step in what we call a food chain. A primary consumer such as a rabbit eats the producer and in turn becomes the meal of a secondary consumer, the owl. Another example of a simple food chain starts with the producer dandelion, which is eaten by the insects (primary consumer). Toads (secondary consumer) feed upon the insects. The toads are a source of food for garter snakes, and the garter snakes, in turn, are eaten by hawks. These are simple illustrations of food chains, but the forest community is more complex.

The food web is a more accurate picture of the interaction of the forest. Acorns, for example, furnish food for squirrels, mice, and chipmunks; each of these primary consumers are fed upon by a variety of secondary consumers such as owls, hawks, skunks, and foxes.

In autumn the fallen leaves provide food for the decomposers. The decomposers bring about the decay of plant material and produce a soil rich in organic matter. This rich soil provides an ideal environment for seeds to grow into new plants.

There is cooperation between some plants and animals. The relationship between flowers and insects is necessary for the reproduction of many plant species. The insect visits the flower to obtain the sweet nectar for food and carries away pollen to another flower for fertilization. Ants milk aphids (minute sucking insects) for their sweet secretion without harming the aphids. The aphids are often transported from plant to plant by the ants. In this way the aphids benefit by getting a better food supply.

In parasitism the relationship is advantageous to one partner, but harmful to the other. Parasites are no different from animals that live on plants or other animals. Usually the parasite obtains its food without killing the host, but it is always detrimental to the host in one way or another. In some cases it may merely weaken the host leaving it susceptible to other organisms. It is rather doubtful that any organism is without some sort of parasite. Ticks, lice, tapeworms, roundworms, and the fungi which cause ringworm and athlete's foot are all parasites.

It is not the purpose of this unit to do an in-depth study of the pond, but most of the forests in the Parkway area have streams or brooks fed by springs. Some of these streams are wet weather streams (dry except after heavy rain). Life along the stream will take on different

characteristics than life in the rest of the forest.

Some organisms live both in the water and on the land. Some plants, though rooted in the water, rise above the surface. Animals, such as the mosquito, live part of their life cycle in the water and part on land. The muskrat and raccoon use the stream for much of their food supply. Here again we see interrelationships, but this time between the water community and the land community.

If the water community in the forest is a pond, the richest soil will probably be found at the bottom of that pond. This is due to many organisms that die and settle to the bottom.

Rocks in the stream provide shelter for tiny fish and aid in the aeration of the water. Temperatures will be different in the stream than in the soil of the forest. Water takes longer to warm up, but once heated retains that heat longer.

Upon stepping into a forest we venture into a very different world, a world of sound and silence and of similarities and differences. It is our contention that it is not necessary to be able to identify by name every organism present for appreciation of the forest community.

By approaching the forest through an understanding of similarities and differences, a real awareness can be generated. In the summer, green is by far the predominate color, but is it all the same shade of green?

Each species has its own identifying features. The bark of one hickory tree is different from the bark of another type of hickory.

Leaf arrangement and composition is yet another way of comparing plants. A leaf may be simple or compound and recognized by the single bud at the base of the stem. The leaves of some trees have stems that are very short, while other trees have long-stemmed leaves. Leaves are opposite, alternate, or whorled on a branch. Compare leaves for texture. Are they smooth, hairy, shiny, or dull? Compare upper and under sides for likenesses and differences.

Autumn provides us with another means of classification, color. Leaves change color when the chlorophyll disappears. Do some trees change color sooner than others? Which trees retain their leaves during the entire winter and which are the first to shed their leaves?

Trees can be classified by shapes. Cedars, oaks, and pines are cone-shaped, while elms, hickories, maples, and scyamores are among the circular trees. Some trees are shaped like columns, such as the sassafras and poplar. Circular trees, upon reaching maturity, tend to spread out taking on the appearance of umbrellas.

To the casual observer a forest may seem to be devoid of animal life. In order to survive in an environment an organism must adapt to its surroundings. Color plays an important part in this survival. Many animals are camouflaged from their enemies by a variety of colors and shapes. The walking stick is brown, long, and thin, closely resembling

twigs. Many insects are the color of the plants they feed upon. The mother bird often is dull in color and not easily seen while nesting. Deer and field mice blend in with their natural surroundings. The forest area is teeming with life, much of which can be observed only by the watchful eye.

Temperature changes have an effect on the kinds of plants and animals in an area. In the winter the plants that cannot stand freezing temperatures either die or become dormant. Animals that depend upon these plants for food either leave the area or go into hibernation for a time. Many birds and even some butterflies migrate to the south in the fall, to a region where food is more plentiful and temperatures are more suitable. Fur-bearing animals develop a thicker coat to combat the winter temperatures.

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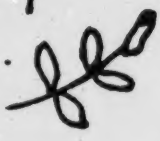
LEAF ARRANGEMENTS

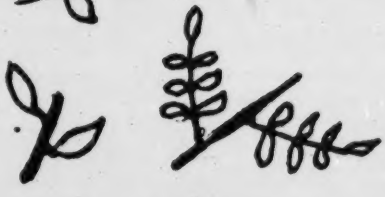
Trees have many kinds of leaves.

Some have simple leaves . . . . . .

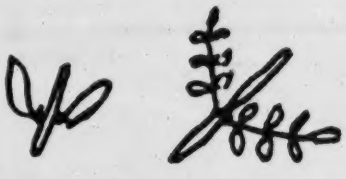
Others have compound leaves . . . . . .



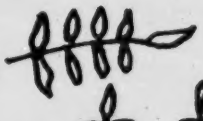
Simple and compound leaves may be alternate . . . . . .



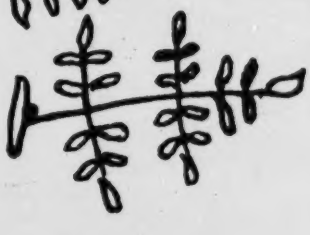
Or opposite . . . . . .



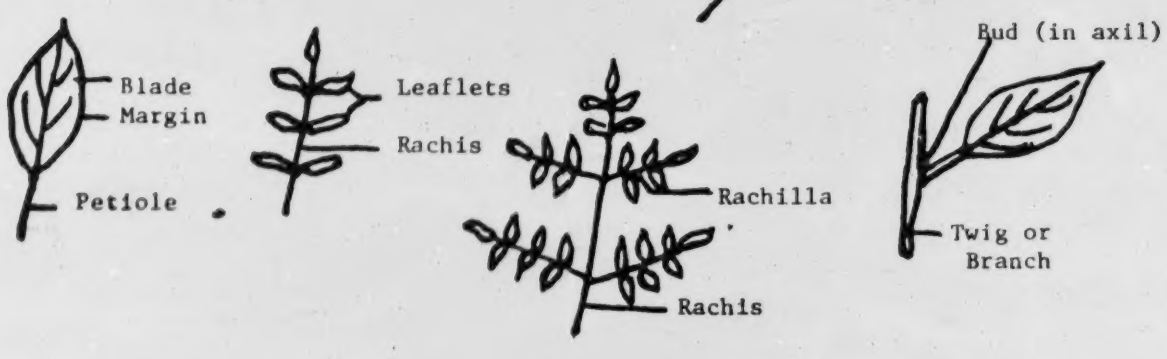
Some compound leaves are pinnately compound. . . . . .



Bi-pinnately compound . . . . . .



Or palmately compound . . . . . .



7. If the forest, at a superficial glance, seems devoid of life, it doesn't take much time for the careful observer to be aware of the many signs of activity in this environment. The ear will detect life long before the eye. Animals communicate with one another through sound. They have sounds for warnings, expressing contentment, mating, and establishing their territorial rights.

Sounds vary at different times of the day or night. Aside from the animal sounds, other sounds typical of the forest can be heard. Wind (abiotic factor) produces the sound of rustling leaves and branches rubbing together. Creaking, ice-laden branches in the winter and rain drops dripping from leaves are all unforgetable sounds. Depending upon the individual, forest sounds can communicate a feeling of serenity, peace, and calm or one of terror and uneasiness.

Wildlife needs a suitable habitat in which to carry on the normal life processes. All living organisms are part of the web of life through the food chains. Man has often upset this web of life through removing animals that hunt and eat other animals; by introducing new animals into an area; and by changing the nature of an area. Usually the most effective approach to conservation is through a study of the whole community to avoid destroying the balance of nature. In the past natural resources were often exploited for the quick profits of a few people. As a result, the nation and the world have been left poorer.

The balance of nature is a fragile line and was so even before the influence of man. Any time this balance is upset certain members of the natural community are affected, and the result may mean the extinction of certain plant or animal species. In recent eras man has too often been the agent of destruction, either as the predator or as the agent of change which brought about certain conditions that proved intolerable to a species.

9. It is only in recent years that man has become aware that, in changing the environment to serve his needs, he is making serious alterations that affect his environment. In our country today eighty percent of the population lives in urban communities. Large areas of the environment have had to be altered to serve these communities, and are no longer suitable for many plants and animals. Diversity of life is a natural occurence and man must fully understand the interactions of organisms before he attempts to control these organisms.

Soil, water, plants, and animals are natural resources. As man uses these resources or alters them so that they are no longer useful for most living things, he becomes a limiting factor in the environment. Wise use of the environment is known as conservation.

Some men are devoting their lives to learning how to grow bigger and better trees, how to harvest the trees without waste, and how to control insects and disease which attack our woodlands. One practice in forest management is known as selective cutting. In selective cutting only trees of a certain size, type, or age may be cut, thus leaving the younger trees more room to grow and develop. Improvement cutting is done by cutting down the less desirable trees (crooked, diseased, aged, or dead) to make room for the more valuable ones.

Another practice is block cutting, which means cutting down areas or blocks within the forest. The trees around the block will eventually reseed the area allowing it to grow back naturally.

Preventing forest fires is one of many conservation measures. Forest fires fall into two categories: naturally caused and man caused. Lightning is the most common natural cause of forest fires. Fires caused by man may be either planned or accidental. Accidental fires are often caused by man's carelessness. "Fire is the greatest single factor responsible for the poor condition of Missouri's forests."*

Man uses the resources of the earth to support himself and to improve his way of life. It is of prime importance that man use these resources wisely. Fertile soil is a very precious resource because it is essential, scarce, and easily ruined. Today, of all the basic resources, it is soil that has been damaged. We must come to the realization that our only wealth lies in what the basic resources can provide for us. Keeping this in mind we must learn to use the forest without destroying it. This is the only way we can prepare and plan for the future.

The forest provides numerous occupations and careers for man. Careers in the conservation of renewable natural resources include wildlife and fish management, forestry, and range management. Other occupations are:

forest ranger	ecologist
naturalist	teacher of ecology
biologist	outdoor recreation director
lumberman	watershed manager
mining resource specialist	paper resource specialist
	conservation law enforcement officer

Opportunities for a career are limited, however, unless one becomes a professional. This means obtaining a college education. That education should be broad enough to provide an understanding of the inter-relationships of the natural resources which make up the environment; the social, political, and economic forces that influence natural resource management; and the ability to analyze natural resource problems to find realistic alternative solutions.

Student career preparation often begins with personal motivation inspired by a teacher. Activities such as nature walks, bird watching, insect collecting, and nature photography play an important role in getting children interested and involved.

It is the purpose of this unit not to create budding botanists or zoologists, but to generate an awareness and appreciation of nature's

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*Missouri Conservation Commission, Forestry in Missouri, p. 9.

great gift to man. It is through such an awareness and appreciation of the total forest community that man will be led to build rather than destroy, to use rather than misuse.

INSTRUCTIONAL SEQUENCE

1. Administer pre-post test.
2. Room preparation:
   a. Bulletin board
   b. Books
   c. Table
3. Order films. Check with your librarian for references.
4. Plan and reserve dates, buses, etc. for field trips.
5. Lesson plans*
   a. Distribute to each student the activity for which he is responsible.
   b. Discuss the activity for the day.
   c. Divide the class into groups, if necessary, for the activity.
   d. Come back to the classroom and discuss activities done outdoors.
   e. Do research, if necessary, to complete the activity.
   f. View films, etc., to expand the activity.
   g. The teacher should check results and evaluate each child's work in terms of meeting the criteria of the behavioral objectives for the activities.

*Sequence of activities may be altered to meet individual class needs.

FIGURE A

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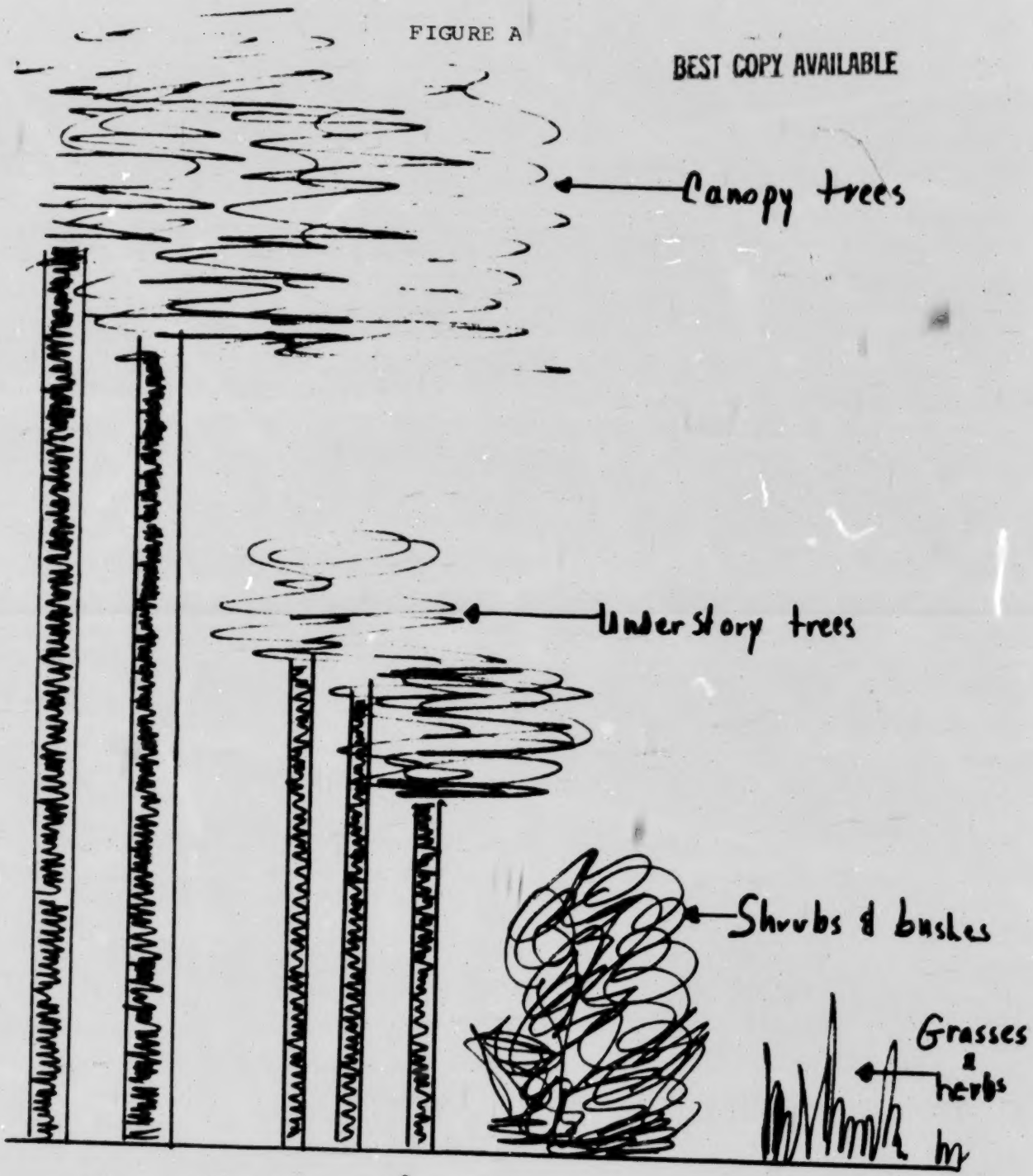

Cross-Section of a Forest

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OUR FRIEND, THE TREE

In the midst of the environmental uproar, the tree stands by -- like a faithful watchdog -- dispensing life-giving benefits and lives on -- like a silent lapdog -- taken for granted, and yet one of man's best friends.

Trees help supply oxygen we need to breathe. Yearly, each acre of young trees can produce enough oxygen to keep 18 people alive ...

Trees help keep our air supply fresh by using up carbon dioxide that we exhale and that factories and engines emit ...

Trees use their hairy leaf surfaces to trap and filter out ash, dust, and pollen particles carried in the air ...

Trees dilute gaseous pollutants in the air as they release oxygen ...

Trees can be used to indicate air pollution levels of sulfur dioxide, just as canaries were once used to detect dangerous methane gas in coal mines ...

Trees provide food for birds and wild animals ...

Trees lower air temperatures by enlisting the sun's energy to evaporate water in the leaves ...

Trees increase humidity in dry climate by releasing moisture as a by-product of food-making and evaporation ...

Trees give us a constant supply of products -- lumber for buildings and tools, cellulose for paper and fiber, as well as nuts, mulches, oils, gums, syrups, and fruit ...

Trees slow down forceful winds ...

Trees cut noise pollution by acting as barriers to sound. Each 100-foot width of trees can absorb about 6 to 8 decibels of sound intensity. Along busy highways, which can generate as much as 72 decibels, this reduction would be welcome to residents...

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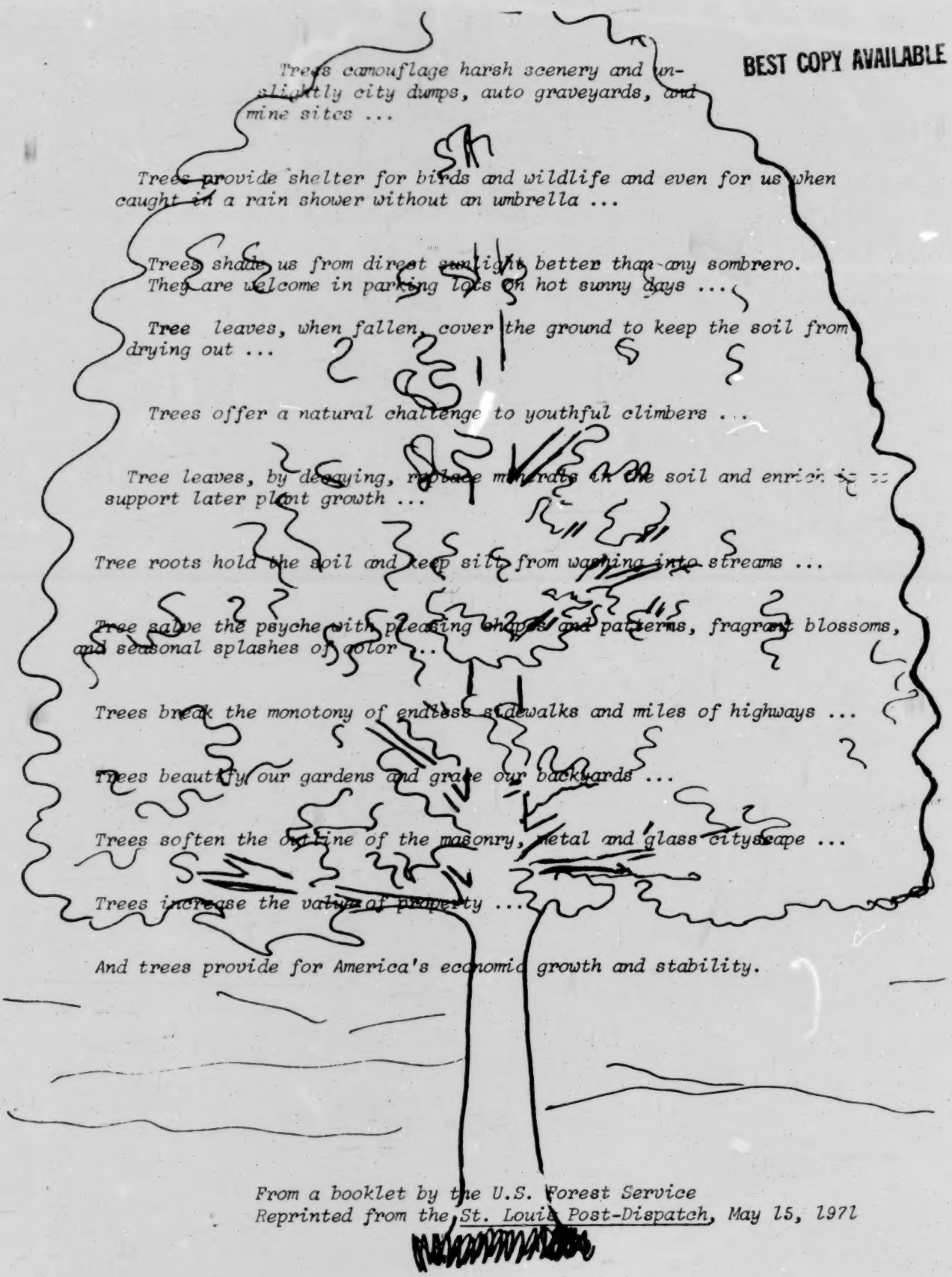

Trees camouflage harsh scenery and unsightly city dumps, auto graveyards, and mine sites ...

Trees provide shelter for birds and wildlife and even for us when caught in a rain shower without an umbrella ...

Trees shade us from direct sunlight better than any sombrero. They are welcome in parking lots on hot sunny days ...

Tree leaves, when fallen, cover the ground to keep the soil from drying out ...

Trees offer a natural challenge to youthful climbers ...

Tree leaves, by decaying, replace minerals in the soil and enrich it to support later plant growth ...

Tree roots hold the soil and keep silt from washing into streams ...

Trees salve the psyche with pleasing shapes and patterns, fragrant blossoms, and seasonal splashes of color ...

Trees break the monotony of endless sidewalks and miles of highways ...

Trees beautify our gardens and grace our backyards ...

Trees soften the outline of the masonry, metal and glass cityscape ...

Trees increase the value of property ...

And trees provide for America's economic growth and stability.

From a booklet by the U.S. Forest Service
Reprinted from the St. Louis Post-Dispatch, May 15, 1971

TEACHER PREPARATION FOR UNIT

I. Read concepts, behavioral objectives, pre-test, instructional material and post-test.

II. Prepare bulletin boards. Suggestions:

a. Cross-section of a forest.

b. Diagrams or outlines of leaves that will be found in the forest. Real leaves might be pressed and mounted. Children could help label them and add any you do not have. Be sure to have in a prominent place the dominant trees of your woods - oak and hickory.

c. Pictures of plants and animals found in the forest. Great material is available free from Missouri Department of Conservation. (See Bibliography)

d. Our Friend, the Tree

III. Table - Suggestions

a. Collections appropriate to the unit.

b. Wood samples (do not cut living material for this)

IV. See enclosed bibliography and check with school librarian.

Activity Number 1

Quadrat Study

This study may be the most important activity of the unit. It should be done carefully and accurately. Before the children are assigned on a select quadrat, the teacher should assess the wooded area and know which quadrat(s) would be most appropriate for fulfilling the behavioral objectives and activities.

A quadrat is nothing more than a square or rectangle of exact measurements enclosed by four stakes with rope or twine. For purposes of this unit, it is recommended that each student (if the woods are large), or each group of students (if the woods are small), take a quadrat 10 meters by 10 meters. If quadrats are adjacent to one another, a composite inventory can be charted on a bulletin board in the classroom. The quadrat can then be broken into 100 small quadrats so that trees, or whatever you desire to inventory, can be more easily transposed to a scale drawing. Each student should make two copies of every inventory: one for the composite study for the bulletin board and one for his own record.

The quadrats take time to set up, and if stakes and rope are used on some school sites they may be destroyed by pranksters or vandals if left over-night. Therefore, a less desirable but perhaps more workable solution would be to set up the quadrats using natural objects, such as trees, as the "corners" of the square. The students will then be able to pick their spot each time from the physical features of the wooded area by only setting up and taking down a rope each time they work in their quadrat. Figure B, a model of a 10 meter by 10 meter quadrat, would have to be modified to fit such a situation.

Mapping and scale drawing skills will have to be discussed and adjusted to the level of academic sophistication of the class.

The class should decide on a key for each item that will be inventoried. A child might determine his own key for items of interest not included in the master key, (see Figure B).

When all the quadrat inventory sheets are placed on the bulletin board according to their relative positions, then the entire group's inventory can be charted and totaled, (see Figure C). From this data, problems can be posed and conclusions drawn depending upon the concept being taught.

FIGURE B

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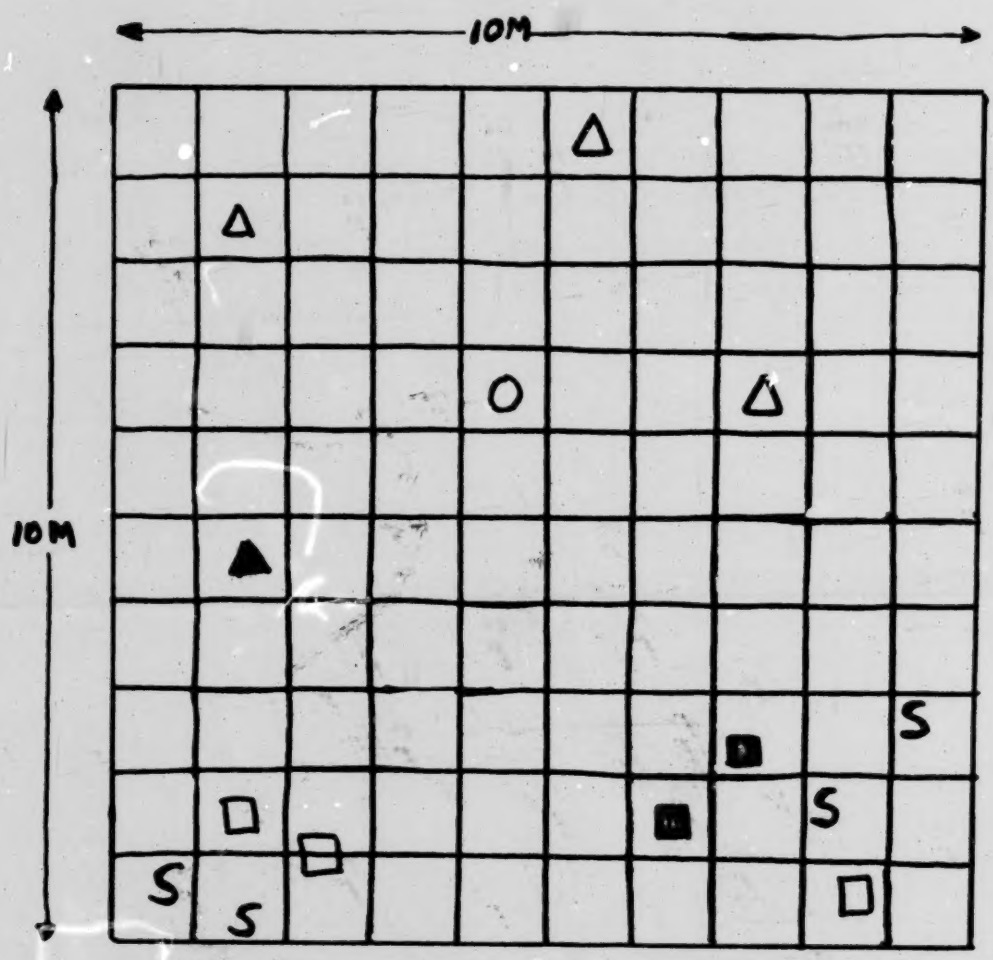
Sample Quadrat Inventory of Trees



KEY:		How many	Percent of total
Shagbark hickory	○	1	7.14 %
White oak	△	3	21.43 %
Pin oak	▲	1	7.14 %
Red bud	□	3	21.43 %
Dogwood	■	2	14.28 %
Sassafras	S	4	28.57 %
Total		14	100.00 %

FIGURE C

Bulletin Board Quadrat Inventory

Composite or Master of Woods

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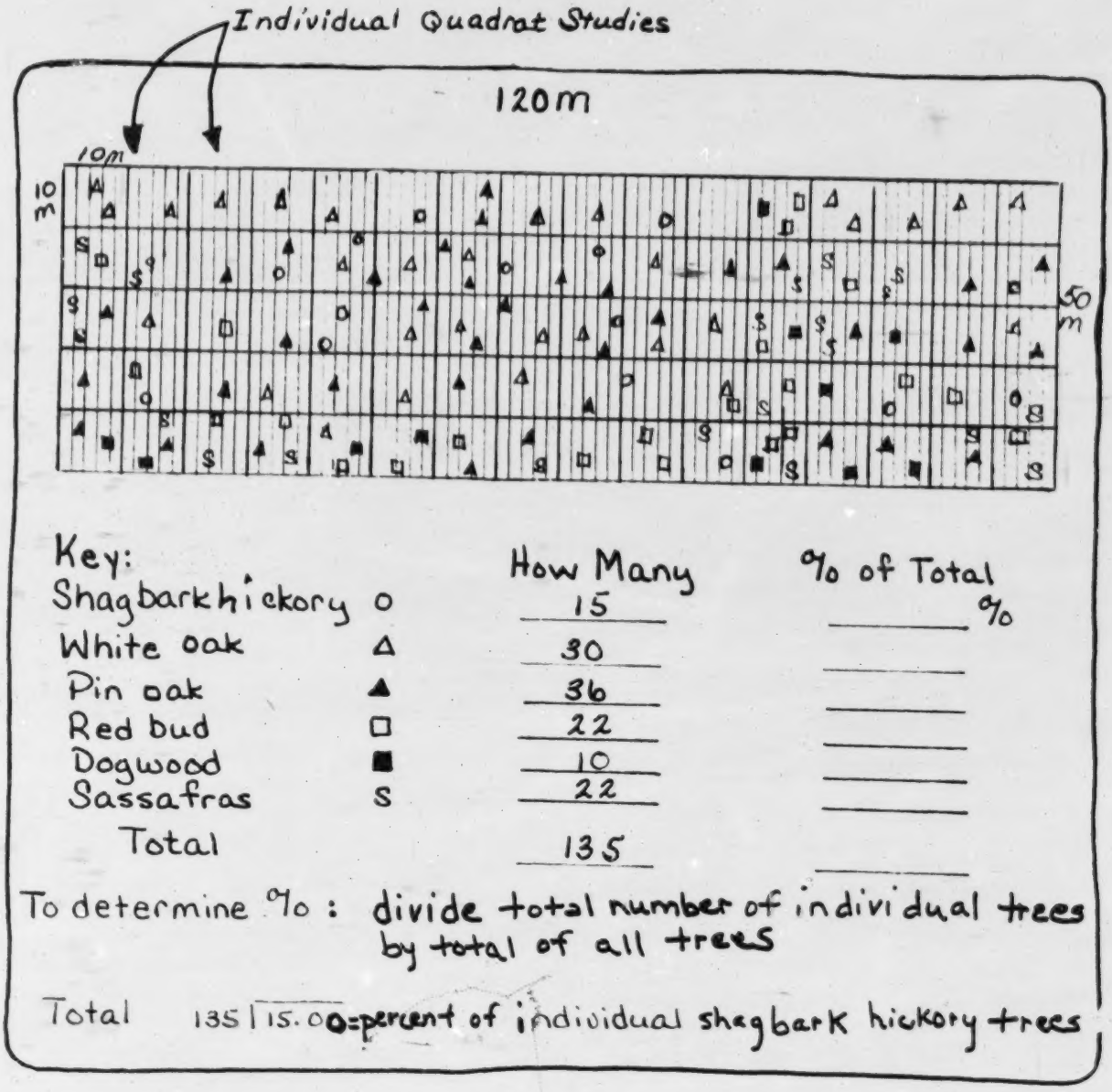

Key:		How Many	% of Total
Shagbark hickory	o	15	%
White oak	Δ	30	
Pin oak	▲	36	
Red bud	□	22	
Dogwood	■	10	
Sassafras	S	22	
Total		135	

To determine %: divide total number of individual trees by total of all trees

Total 135 | 15.0 o=percent of individual shagbark hickory trees

Activity Number 2

To develop an understanding of moisture as the dominant abiotic factor in a wooded area:

1. From research, the class can determine the average annual rainfall in the vicinity of the woods being studied. St. Louis or Missouri averages will be sufficient. Then, from a quadrat inventory, determine what kind of a forest grows well in Missouri.

2. Rain gauges can be placed in various places in and around the wooded area; e.g., under a tree, in a clearing in the woods, near the top of a canopy tree, or in an area outside of the woods. Discuss such observations as why discrepancies in amounts of rainfall occur, why certain areas tend to erode, and why the forest floor remains so moist even though the rain gauge indicates that it receives less rainfall than open or higher places.

3. Fach student, using a compaction gauge (see Figure D), should make several measurements in his quadrat and record the results on a master data sheet. The activity could be expanded to compare the soil compaction of a forest floor, a field, a playground, a path, etc. (see Activity 5).

   A forest is affected by soil compaction because the more compacted the soil becomes, the less readily does it absorb moisture. Scientists have been studying this condition for many years. In one experiment, they found that pine trees planted in compacted soil grew only half as much as trees of the same species planted in normal soil. In the natural environment, compacted soil is gradually loosened by the roots of plants and by some animals, such as earthworms. But scientists estimate that it takes about forty years for compacted soil to become loose enough for plants such as pine trees to grow at their usual rate.

4. Fill two jars or plastic containers with the same kind of soil, preferably taken from the wooded areas. In one of the jars have a student press the soil firmly with his fingers or a blunt stick. Leave the soil in the other jar loose. Then pour equal amounts of water (about two ounces) into each jar. Observe how long it takes for the water to reach the bottom of each jar.

FIGURE D

Soil Compaction Gauge

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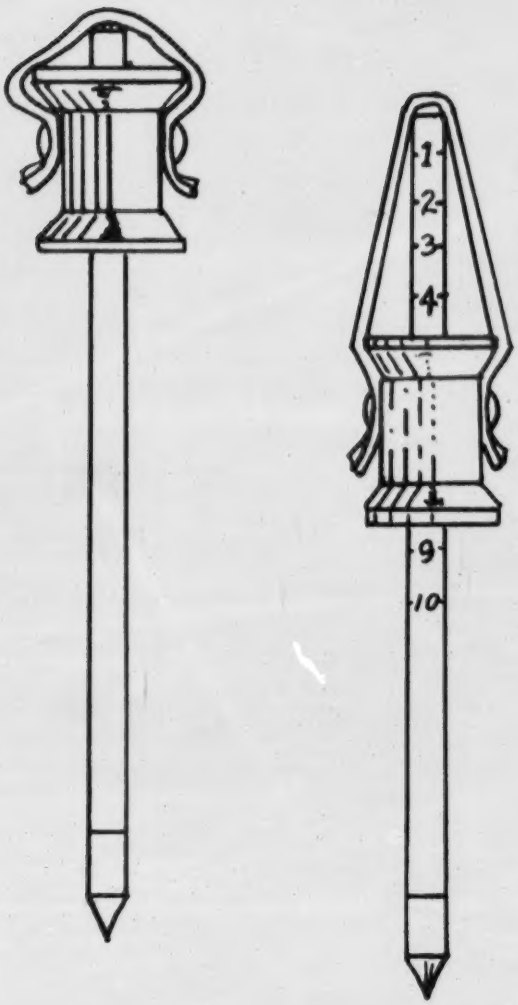

USING A SOIL COMPACTION GAUGE

Materials

Soil compaction gauge, #5 juice can, pencil, paper, 12-inch plastic ruler, quart container of water, and a wrist watch.

Instructional Procedures

To make a simple soil compaction gauge, each pupil will need the following: two thumbtacks, a wide rubber band (#84 rubber bands are about one-half inch wide), an empty thread spool, and a 9-inch length of dowel that will slide easily inside the spool.

First, sharpen one end of the dowel with a knife or in a pencil sharpener. With a ruler, measure one inch from the point and mark a dark line. Then measure from the unsharpened end of the dowel and mark off ten lines, each a half-inch apart. Number these lines, starting with number 1 near the unsharpened end. Fasten a wide rubber band to the top of the spool with a thumbtack on each side (see illustration). Note: For sagety purposes wrap ½" wide masking tape over the thumbtacks and completely around the spool at least three times. The soil compaction gauge is now ready to use outdoors.

Slip the dowel into the spool and push down on the spool, forcing the point of the dowel into the soil up to the dark line. When the pointed end is in this far, read the number at the top edge of the spool. This number indicates the soil compaction reading for that location.

5. To begin examinations of water absorption, pick a sample location on a quadrat. Press the compaction gauge into the soil up to the bottom one-inch mark. Immediately take a reading at the top edge of the spool. This is the soil compaction number for that location. (See Activity 3).

6. Take a #5 tin can with both ends removed. Force it into the soil around the spot where the compaction reading was taken by placing a board over the top of the can and hammering or stepping on it. Quickly pour one quart of water into the can and keep a record of the time that it takes the water to soak into the soil. By using a plastic ruler, it is also possible to keep a record of the depth of the water in the can at regular intervals, say five, ten, or fiftenn seconds. Repeat the process in other locations and compare the results. Students may wish to estimate the compaction and absorption rates before actually beginning their tests, based upon their findings in similar areas. Record important information about soil, plant cover, evidence of erosion, and other factors which may affect soil compaction and absorption rates.

7. Select an area in a lawn about one square meter in size. Compact the soil with the heel of a shoe, a shovel, or a hammering tool. Compare the growth of grass or other plants in the compacted area to the grass and other plants in surrounding areas over the next several weeks.

8. Collect samples of as many different types of soil as you can: sand, clay, and humus. Take three empty #5 juice cans and remove one end from each. With a hammer and nail, punch about ten holes in the remaining end; fill the cans with soil samples and press down firmly. Pour equal amounts of water into each can and record the time it takes for the water to start leaking from the cans and the length of time it takes for most of the water to run out. What conclusions can be drawn about which kind of soil is most porous? Place a container under each can and determine which kind of soil retains more water. The soil samples might also be weighed before and after this experiment to help reach a conclusion.

9. Investigate the properties of different types of soil, especially compare forest-floor soil with clay-like soil. Pour equal amounts of each kind of soil into two glass jars. Fill each jar with water. Shake or stir vigorously until the soil sample breaks up completely. Let each jar settle into layers.

10. See the film "Water Works For Us".

11. Discussion questions relating to moisture as the dominant abiotic factor in a wooded area:

    a. Why is water the <u>dominant</u> abiotic factor in determining the kind of woods you will find in a specific location?

    b. How is soil affected by moisture?

    c. How is the air in the woods affected by moisture?

d. What would happen if it did not rain for a long time?

e. What would happen if it rained and rained and rained?

f. What is better - a soft, gentle rain yielding one inch of water or a quick, hard shower yielding one inch of water? Give reasons for your answer.

g. How does the vegetation look on the north slope of a ravine as opposed to the south slope? If it looks different, what makes it different?

h. Why do we have deciduous trees in this kind of a forest?

Activity Number 3

To determine the characteristics of the dominant tree species in a forest:

1. Using the quadrat study as introduced in Activity Number 1, inventory each section of the wooded area for understory and canopy trees. These inventories are to be placed on a master bulletin board and tallied. If the wooded area you are inventorying is a climax forest, most of the trees will be oak and hickory; and you will have to explain that this wooded area has not completed the succession process. Understory trees will eventually be crowded out by oak and hickory which, as seedlings, thrive in shade and as full grown trees require full sun. When the oak and hickory overtake the understory trees, the latter will not survive since they also require full sun.

2. A field trip to an area such as Babler State Park or Arboretum at Gray Summit, Missouri would provide the students with an opportunity to see a climax forest.

3. Have the students observe similarities and differences between oak and hickory trees and record their observations on a data sheet (see Figure J, p. 49).

4. A group may be interested in trying to measure a tree by using indirect measurement techniques. Three simple methods are:

   a. Inch-to-foot method

      Starting from the tree, walk eleven steps or measure eleven units and mark the end point with a long stick, placed perpendicular to the ground. Then measure off one additional unit and mark that point "A". Sight from point A across the stick to the top of the tree. Mark the point on the stick where your line of vision intersects the stick "B". Measure the distance from point B to the ground in inches. This will be the height of the tree in feet.

   b. Tree felling method

      Hold a stick vertically in your hand, arm outstretched. Sight to the tree you want to measure. The tip of your stick should be even with the top of the tree and your thumb should mark the bottom. Then move the stick 90 degrees to the right or left. Notice the point where the bottom of the stick hits the ground, making sure that the foot of the tree and your thumb still line up. Step off the distance from this point to the foot of the tree to obtain the height.

   c. Pencil method

      Measure a student to determine his exact height. Then have him stand beside a tree. Stand at a distance from him and, holding

a pencil at arm's length, sight across the top of it to the top of his head. Slide your thumb up or down on the pencil until you are able to sight across the top of your thumb to his feet. Keeping the thumb at this point on the pencil, raise the pencil upward until you can sight across the top of your thumb to his head. Now sight across the top of the pencil to a new point on the tree. Repeat until you have reached the top of the tree. The height of the tree is the number of standards lengths of the pencil times the person's height.

Activity Number 4

To explain how major plant species can continue to replace themselves in a climax forest instead of being replaced by other species:

1. If your woods is indeed a climax forest, have the students closely inventory the quadrats containing canopy trees and look for tree seedlings. These tree seedlings will be of the same species as the canopy trees. There may be other tree seedlings in the area, but they will not be healthy and will eventually die out. Only canopy-tree seedlings will survive to become the canopy layer in a climax forest.

   Note: If you are visiting a climax forest to fulfill another objective you may want to do the above activity there at the same time.

2. If your woods is not a climax forest but contains canopy trees that are either oak or hickory, investigate any fallen logs in the vicinity. If these dead trees are of the same species as the canopy trees, you can infer that canopy trees do replace themselves. If you are uncertain as to what species the dead logs are, use rubbings to compare bark textures.

3. If you have access to a climax forest, you may wish to use the enclosed student data sheet to tally the number and species of tree seedlings under the canopy trees, (see Figure K, p. 51)

Activity Number 5

To study how animal populations are, to a great extent, controlled by the plants present in a forest community.

Make a diagram illustrating a simple food chain. Include a producer, a primary consumer, and a secondary consumer.

Pupils, working in groups, should make a diagram illustrating a food web based upon a wooded area. Show a producer, two or more primary consumers, and two or more secondary consumers.

1. Go back to the quadrat and examine the area for any form of animal life (animal life is defined as any living thing that is not a plant). This investigation should be made even by inference; e.g., looking for droppings, exo-skeletons, eggs, animal homes, or animal tracks. A ten-meter quadrat may be too large for one person to investigate for small animal life, but it should be carefully examined for evidences of mammalian, bird, reptilian, and amphibian life such as snakes, turtles, lizards, squirrels, gophers, moles, muskrat, deer, etc.

   The insect population could be inventoried from a smaller portion of a quadrat.

   After the quadrats are inventoried, have each child find out by research what each animal he saw evidence of eats. Some animals might be observed actually eating. Others, especially noctural feeders, will need to be researched. From individual data sheets for each quadrat, make a composite inventory. (see Figure L, p.52) The inventory should be classified as to mammals, reptiles, insects, etc., and separate data sheets used.

   The students then should investigate whether the food the animals eat is actually found in the wooded area.

2. Food Web Game: Each student in the class is given several tags with the names of either a consumer or producer on each. Many different types are to be used. Each student is also given several long pieces of string. After naming what producers and consumers are represented on the tags, the students will hold the end of the string of something they eat in their right hand, and with their left hand match the string to something that eats them. The students should try to get as many strings as possible in either of their hands. The tags can be as simple or as sophisticated as the teacher wishes. See Figures E and F.

Modifications of Food Web Game:

a. Remove one of the elements of the web. Then those consumers relying on this element will overload other food sources, causing an imbalance in the woods and promoting the disappearance of certain

animals.

b. Have the students arrange themselves in food chains, trying to make the chains as long as possible.

c. Have the students make suggestions to expand both food chains and food webs. Be sure they realize they must expand the producer (plant life).

d. Pretend that a forest fire destroys the woods. Discuss what happens to the food web.

Caution: In some classrooms where this game has been used, some children have found it uncomfortable to view themselves as "being eaten" by something else. Make sure they realize that there is nothing personal in this game!!

3. Using inventories of the quadrat, have students diagram food chains. (see Figure M, p. 53).

FIGURE E

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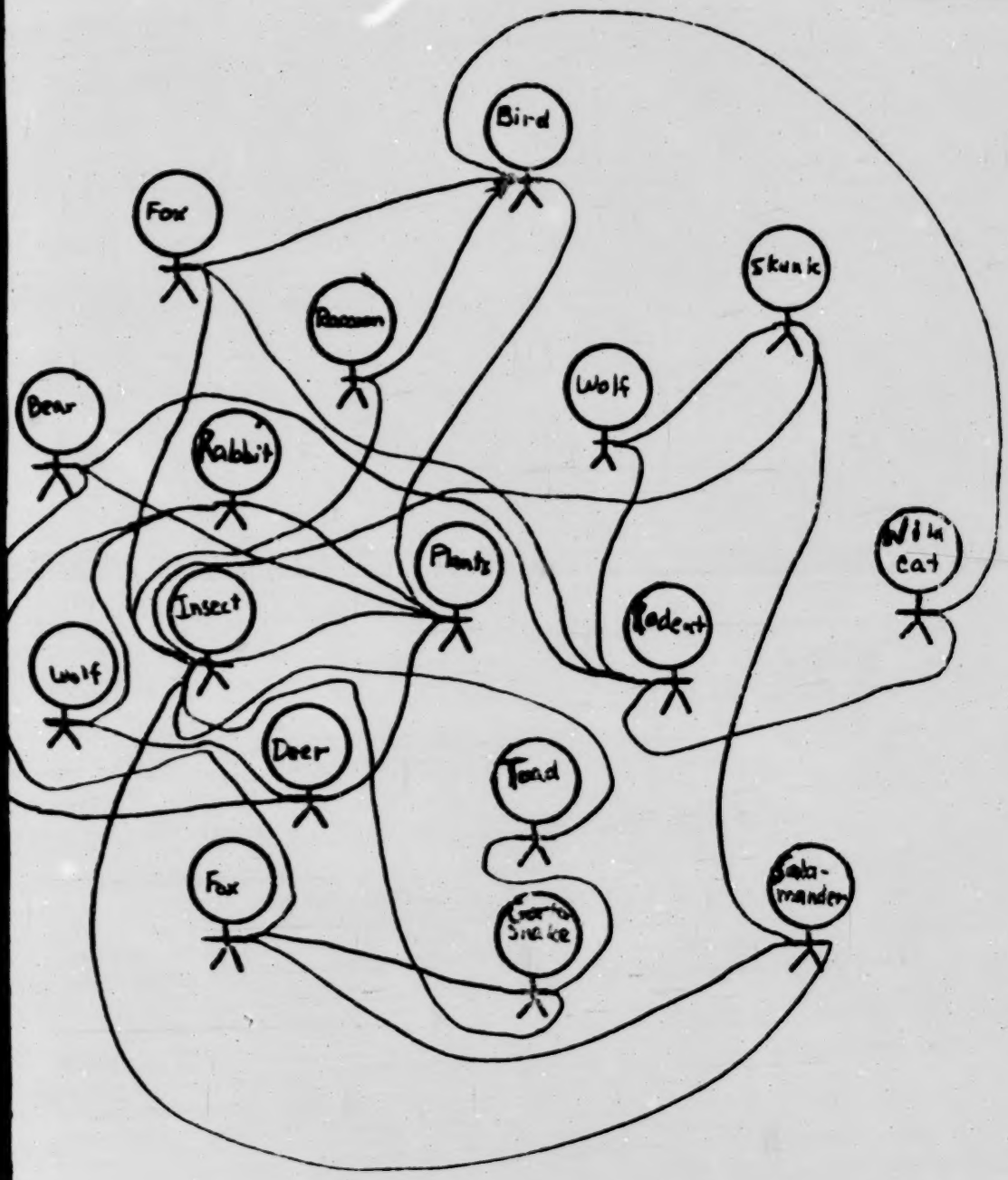

Food Web Game

Rules:

In your right hand ---- Hold the strings of things you can eat

In your left hand ---- Hold the strings of things that can eat you

FIGURE 1

Food Chains

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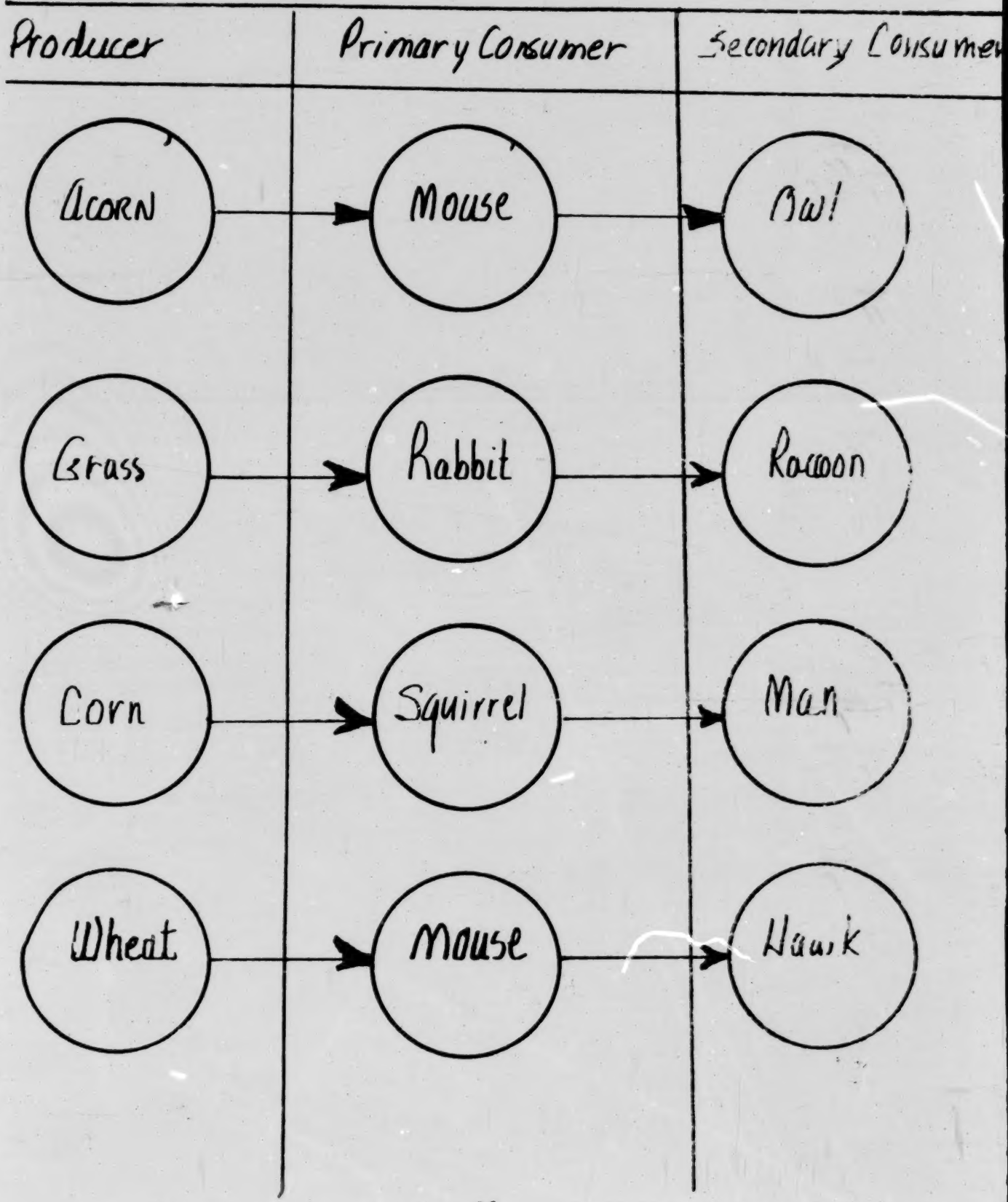

Activity Number 6

To give examples of and defend competition and cooperation in the forest between plants with plants and animals with animals:

1. List on a work sheet the following concepts (see Figure N, p. 55).

   Competition: plant with plant (review succession

   Cooperation: plant with plant (e.g., tree and ivy)

   Competition: animal with animal (e.g., blue jay and robin)

   Cooperation: animal with animal (e.g., aphid and ant)

2. With the children, list on the board ways that man cooperates with man for mutual benefit. This discussion may be expanded to include ways that a classroom can cooperate for the benefit of the entire group.

3. Set up debate teams for debating the following issue: the advantages vs. the disadvantages of competition among men.

Activity Number 7

To understand parasites and their hosts:

1. When doing the food chain activities, be sure to include examples of parasitism. If you have not done this, use the food web game again at this point.

2. Have the children research examples of parasitism. Make cards naming parasites and hosts. Give each child a card and see if he can correctly identify himself as a host or a parasite.

3. An analogy can be made between parasitism and human society. Discuss ways that human "parasites" affect the economy and the well-being of other citizens.

Activity Number 8

Present to the class the following situation: In the past a pioneer cleared a section of forest for cultivation. Later the field was abandoned for a period of thirty or forty years. Arrange the steps of succession in this abandoned field in correct order:

a. land cleared for cultivation

b. corn crop planted

c. land no longer under cultivation

d. grasses and herbs

e. sassafras and cottonwood

f. oak and hickory

1. Make a diorama of a forest developing from an abandoned field (see Figure A, p. 18).

2. Visit an area where succession is in progress. The edge of your woods may be such a place. Point out the abundance of grasses, shrubs, bushes, and understory trees/seedlings. The Missouri Botanical Garden Arboretum and Nature Reserve at Gray Summit and Camp Wyman, Eureka, Missouri are good examples of succession.

3. Predict what would happen if a farmer stopped cultivating an area. Make up a quadrat after five years, ten years, twenty years, thirty years, fifty years, and one hundred years.

Note: To arrange a field trip, write to Box 93, Gray Summit, Missouri 63039, or phone 742-4411 or 865-0440, station 33.

Activity Number 9

To recognize differences and similarities between leaves from trees of different species:

1. Have the students diagram or make sketches of different leaf shapes.
2. Sketch different leaf edges.
3. Sketch different leaf arrangements on twigs.
4. Make a tree recognition key.
5. Make a leaf collection. This can be an individual or class project. Be sure to emphasize that the students must not denude trees in order to do this project.
6. List the similarities and differences between a coniferous and a deciduous tree (see Figure 0, p. 54).

FIGURE G

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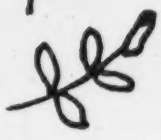
LEAF ARRANGEMENTS

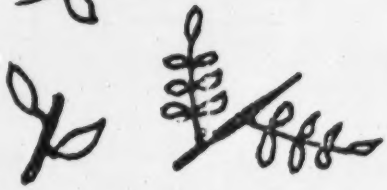
Trees have many kinds of leaves.

Some have simple leaves.....

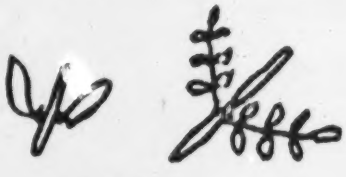
While others have compound leaves.....



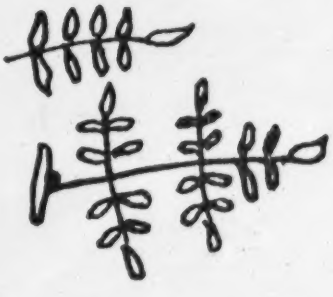
Simple and compound leaves may be alternate....



Or opposite.....



Some compound leaves are pinnately compound....



Bi-pinnately compound.....

Or palmately compound.....

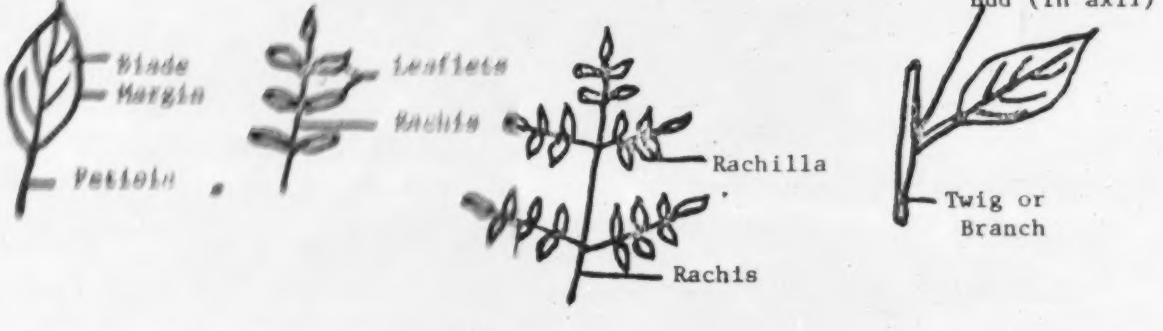


FIGURE H

Leaf Edges

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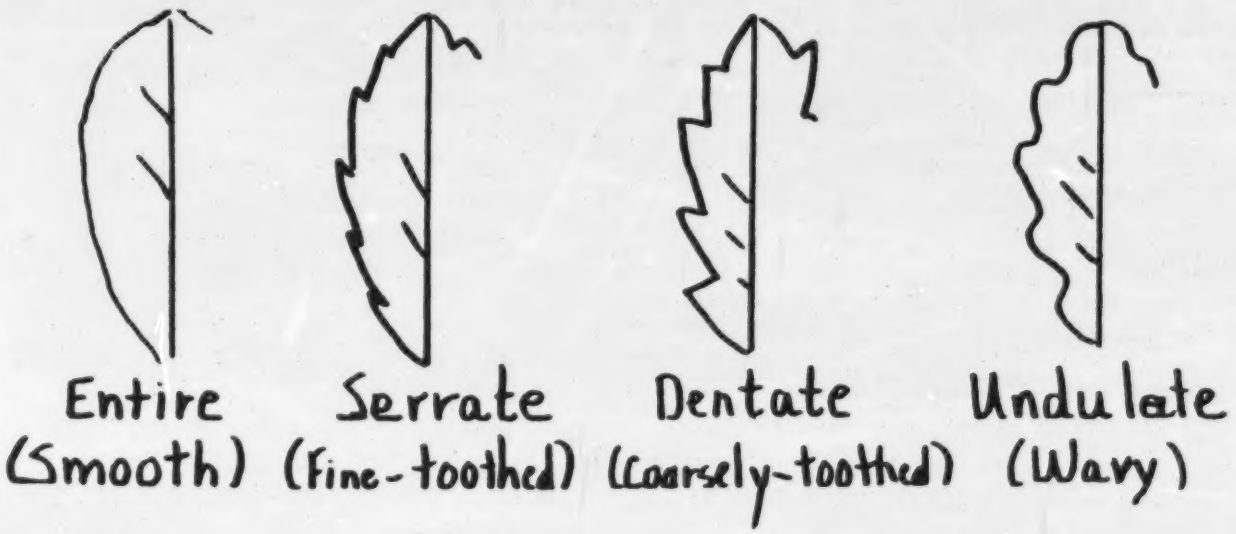

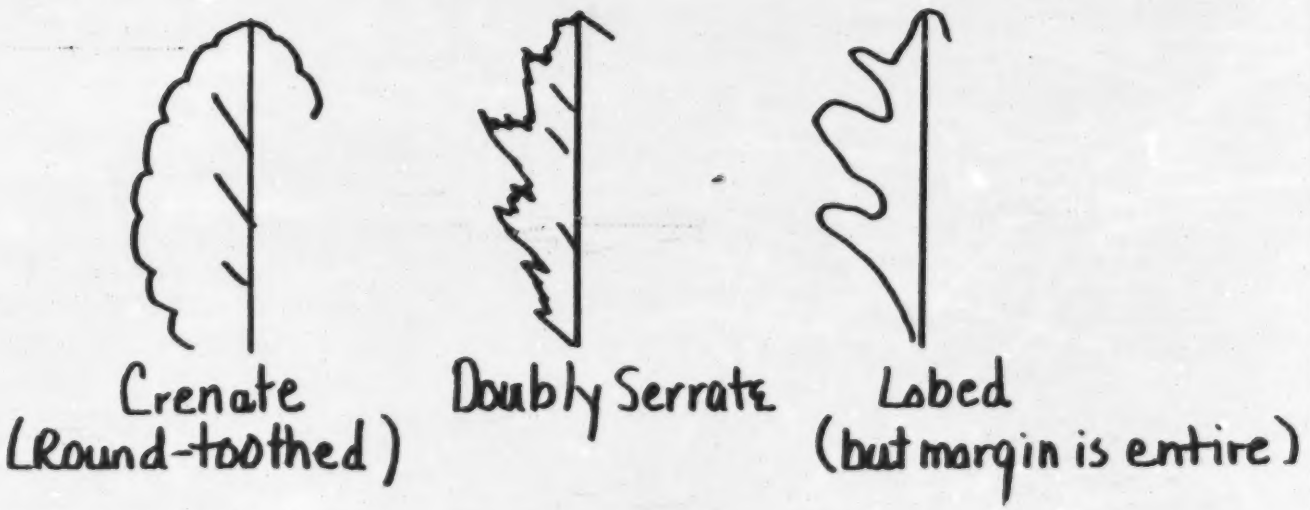

FIGURE I

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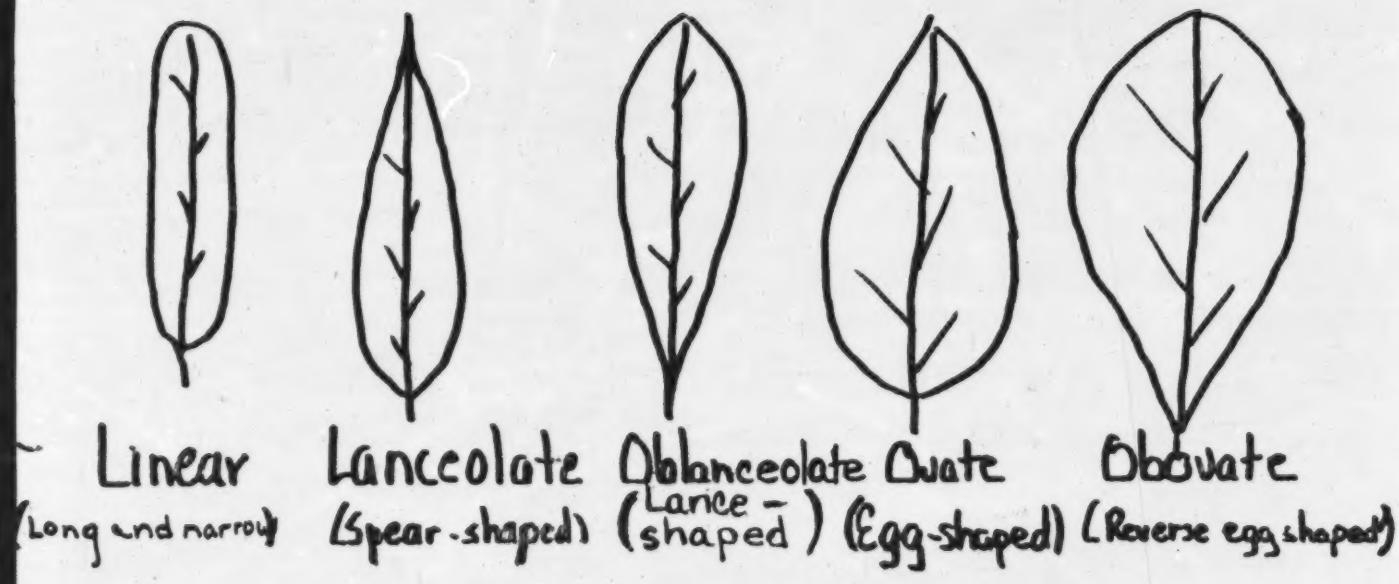
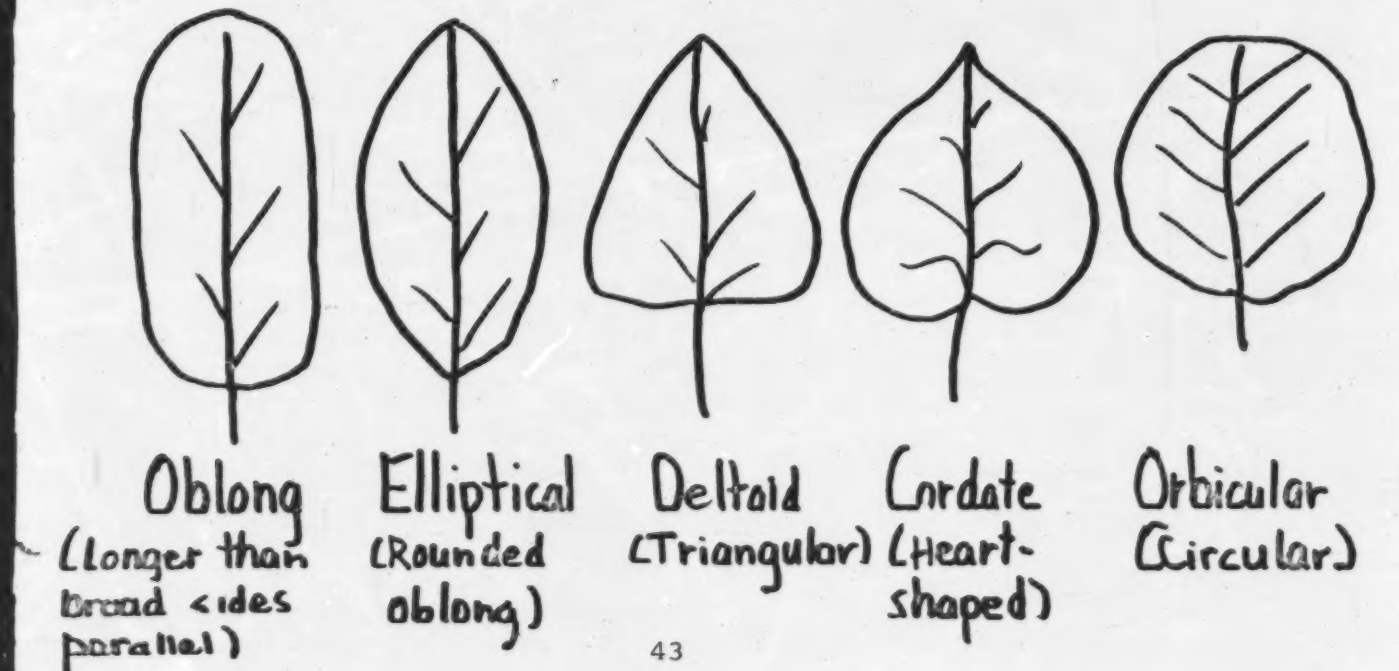
Leaf Shapes





Activity Number 10

To explain how color adaptation affects animals.

Activities:

1. Have the students sketch animals in their natural settings, showing how their color adaptation provides a means of survival.

2. From the quadrat inventory, list and/or reproduce the different colors found in the environment.

3. Toothpick game: Using different colored toothpicks, scatter them in a plot of grass. In a given time, have the students pick up as many toothpicks as they can find. Count the number retrieved. See which color was the easiest to find. Make a tally on the chalkboard and then compute the percent of each color. The children can recognize what colors are easy to spot in a predominantly green environment. Give students a limited time to retrieve the toothpicks (2-3 minutes).

Activity Number 11

To understand how and/or why some elements or the forest community change color with the changes in seasons:

1. Make a collage of different colored leaves observed in autumn.

2. Have the children collect pictures that depict seasonal color changes in a forest. Place them either on a bulletin board or in a scrapbook.

3. Paint or sketch the woods at various seasons.

4. By research, tell why leaves change colors and what factors cause this change.

5. Certain animals also change color from season to season. List or diagram the color changes in several animals.

Activity Number 12

To examine reasons why man partially or completely destroys a forest and reasons why he leaves a forest as is.

Activities:

1. Design a poster or bulletin board showing what man derives from the forest; e.g., lumber, food, paper, etc. (Note: See unit on "Paper" for additional activities.)

2. Make a poster or bulletin board showing how man uses the forest in its natural state for recreation, hunting, solitude, etc.

3. Investigate job opportunities in the forest: forest ranger, park director, lumberman, etc.

4. List the effects of man on the forest:

   Improper use of pesticides
   Indiscriminate hunting
   Pollution
   Inappropriate laws
   etc.

5. Have the students write letters to congressmen and state representatives, as well as to corporations, stating their positions on conservation practices. Make sure that the letters express both positive and negative opinions.

6. Make a list of people who are in a position to change unsatisfactory conservation practices.

7. Take a "trash walk" through your wooded area or around your school.

8. Create a cartoon depicting the problem of pollution.

Activity Number 13

To write poetry or narrative descriptions about favorite trees, reflecting the children's inner feelings toward trees.

Activities:

1. As a class activity, compile on the chalkboard a list of adjectives that come to mind when in a forest.

2. Write poems and descriptive paragraphs and arrange them in a booklet; reproduce enough copies for each student.

3. Pretend you lived in the forest 100, 200, 300 or more years ago. Write a story about the kinds of experiences you might have had.

4. Pretend you are a bird, animal, insect, tree or plant. Write an "autobiography" from that point of view.

5. Draw a picture of your favorite tree.

6. Pretend your favorite tree can speak. What would it tell you? If you wish, illustrate the conversation in cartoon form.

7. Obtain trees from the State Department of Conservation and plant a tree. Each 4th grade child is eligible to obtain a tree without charge.

8. Observe Arbor Day by making posters, planting trees, etc.

9. Examine a stump that shows tree rings. Count them to determine how old the tree was when it was cut. Discuss reasons why the rings are of different widths.

10. After planting a tree, record weekly on a data sheet any observable changes.

11. Diagram the stages through which your favorite tree goes each year: bare limbs, buds, leafing sequence, flowers, fruit, change of leaves, loss of leaves, etc.

12. List adjectives describing a forest fire --- how it would feel if you were in the forest at that time.

13. Write a composition or poem about your favorite tree as it contemplates the constant threat of a forest fire.

Activity Number 14

"The man of the future will need the forest that is planted or preserved today."

Activities:

1. Diagram the various ways a forest is:

   a. naturally seeded

   b. man planted

2. Discuss the opposing philosophies of forest management

   selective cutting vs. strip cutting

   Divide the class into groups and debate the issue involved.

3. Through research, determine the major consumers of lumber; how much of the woods is harvested each year; and how much is reforested.

4. List ways of conserving the products of the forest such as recycling paper, etc.

5. Investigate the present day techniques of harvesting a wooded area. Compare them to those of the Paul Bunyan era. Note modern techniques and the use of specialized equipment.

6. Inquire into the forest fire-fighting methods that are currently in use.

7. Put numbers on approximately twenty trees in your wooded area. Let each student make a chart of the marked trees, stating reasons for cutting or leaving each tree. A tree useful for lumber should have its lowest branches 16 feet above the ground; 32 feet is preferable. Inspect carefully for evidence of disease, fire, animal habitats, and habitant species (not every species is useful in every forest).

8. Project yourself into a future that has no forests. You are now very old and you are telling your great-grand child what a forest was like when you were his age. Tell him how you felt about the forest, and what it did for you. This activity could be done as a play or puppet show.

FIGURE J

BEST COPY AVAILABLE

Student Data Sheet

OAK	HICKORY
Leaf Shape	Leaf Shape
Leaf Arrangement	Leaf rrangement
Bark (Rubbing)	Bark (Rubbing)
Fruit	Fruit

FIGURE J continued

BEST COPY AVAILABLE

OAK	HICKORY
Tree Shape	Tree Shape
Fall Colors	Fall Colors
Flowers	Flowers
Commercial Uses	Commercial Uses

FIGURE K

BEST COPY AVAILABLE

Student Data Sheet

Tally of Seedlings Round under Canopy Trees

Canopy Trees	Seedlings
OAK	OAK
HICKORY	HICKORY

Comments: (Include other seedlings)

FIGURE L

BEST COPY AVAILABLE

Animal Inventory Composite

(Mammals)

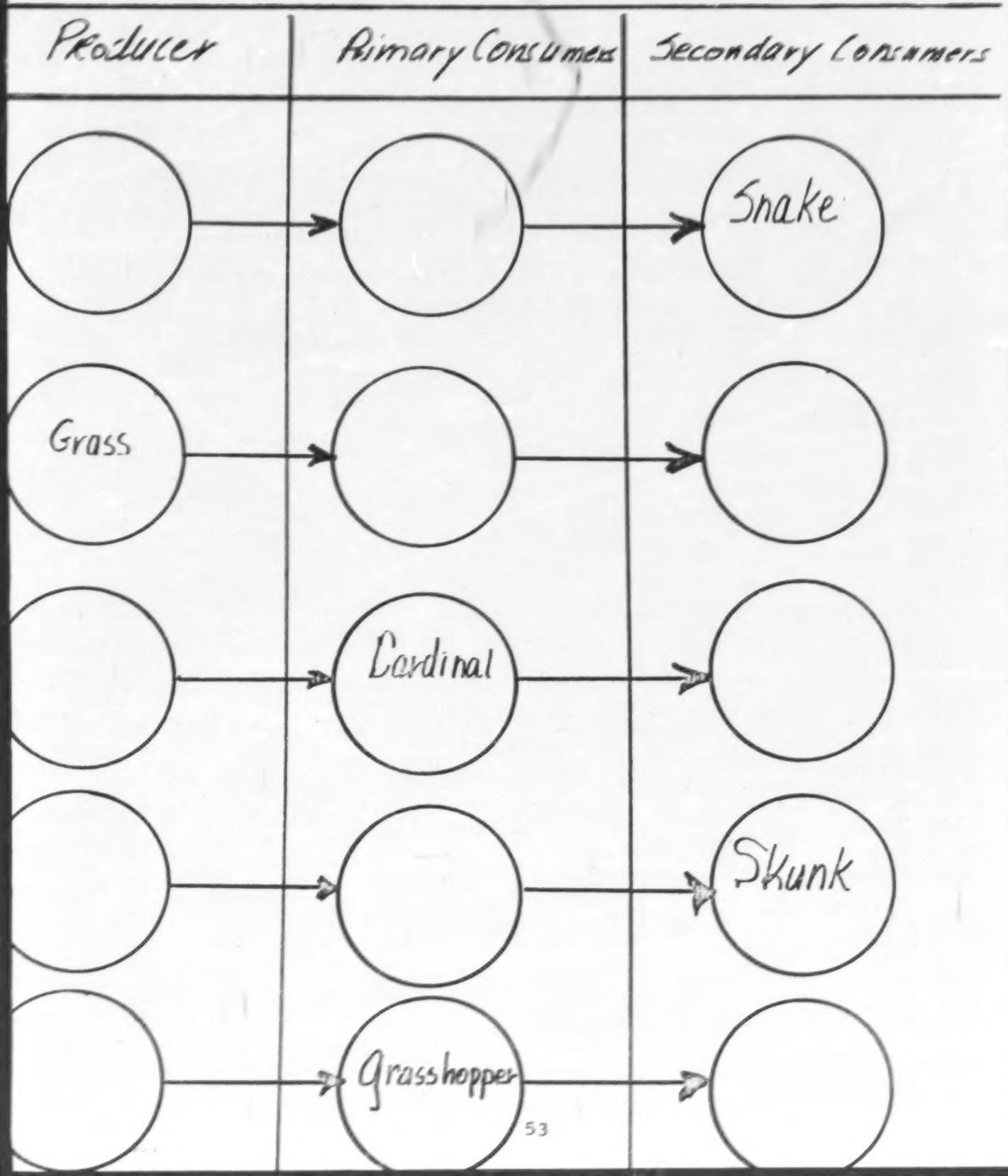
No observed	Kind of Animal observed or inferred by evidence	Foods
14 6	Gray Squirrel Fox Squirrel	nuts; fruit; buds of hickory; pecan, oak, walnut, elm, and mulberry trees; field corn
2	Opossum	insects; dead animals; birds and their eggs; frogs; snails; earthworms; corn; fruit
5	Raccoon	persimmons; grapes; plums; choke cherries; Osage oranges; corn; acorns; cray-fish; insects; spiders; frogs; mice; squirrels; rabbits; muskrats

FIGURE M

BEST COPY AVAILABLE

Food Chains - Student Worksheet

(Arrows Indicate the Flow of Energy)



Coniferous and Deciduous Trends

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LIST SIMILARITES AND DIFFERENCES

	Coniferous	Deciduous
Leaf Shapes		
Flowers		
Fruit		
Seeds		
Kind of Soil		
Amount of sunshine		
Amount of moisture		
Seasonal changes		
Commercial uses		

FIGURE N

BEST COPY AVAILABLE

Student Data Sheet

Cooperation	and	Competition
Plant with Plant		Plant with Plant
Animal with Animal		Animal with Animal

SUPPLIMENTARY ACTIVITIES

To identify the sounds made by two biotic sound producers and one abiotic sound producer.

To identify as to pleasing or displeasing why and/or how the taped biotic sounds affect you.

Activities:

1. Play record of bird sounds. (see bibliography)
2. Make recordings of forest sounds, e.g., birds, insects, wind, rain, and man. (Use these tapes for accomplishing behavioral objectives 14 & 15).
3. Using one sound have the students write an original composition incorporating these notes, (for example, bob white or other bird call).
4. Translate bird songs to notes on a staff as a class activity.
5. Imitate a sound and have the class guess what sound it is.
6. Have each child write a story pretending that he has the power to understand the language of a particular biotic or abiotic sound producer.

To investigate causes of forest fires, both naturally caused and man-caused.

Activities:

1. Have the students gather pictures of woods that have been ravaged by forest fires.

2. Use the Forest Fire Prevention and Conservation Kit, available free of charge by writing to:

   Smokey the Bear
   State Forester
   U.S. Forest Service
   Jefferson City, Missouri

3. Make fire prevention posters.

4. Compose slogans.

5. Write a song.

6. Conduct research to find what, if any, benefits come from a forest fire. Discuss possible reasons for purposely firing a forest.

7. Have the students compose a list of ways that forest fires can be started.

8. Visit a fire tower.

9. Investigate how a forest is protected from fire. Talk about ways of managing the forest to help control fires once started from spreading....fires, breaks, back firings.

VOCABULARY

Abiotic - non-living environment: air, wind, soil, water, temperature.

Biotic - living organisms: plants and animals.

Canopy - the tallest trees in a mature forest (minimum of fifty feet high).

Community - an interdependent group of plants and animals living in a particular habitat or in a restricted area.

Competition - members of a community rivaling one another for food, shelter, and territory.

Cooperation - members of a community helping one another.

Deciduous - trees whose leaves are shed at certain seasons; evergreen or coniferous trees are the opposite.

Decomposer - a microorganism (particularly bacteria, yeast, mold, and other fungi) which breaks down the dead bodies and excreta of organisms into simpler substances.

Food Chain - producer, primary consumer, secondary consumer; from the plant to the plant-eating animal to the animal-eating animal (e.g., clover (producer) to rabbit (primary consumer) to fox (secondary consumer).

Food Web - a series of interlocking food chains; producer, two or more primary consumers, and two or more secondary consumers.

Mutualism - organisms living together, not in competition, but in a relationship which is mutually beneficial (e.g., animal-animal: ant/aphid; plant-plant: fungus and alga.)

Parasitism - organisms using other living organisms for nutrients.

Scavenger - an animal that eats refuse and dead organic matter.

Succession - a sequence of events having a predictable pattern.

Understory - the trees less than fifty feet tall in a mature forest.

GIVE PRE-POST TEST

SEE PAGES 5-6

School_____

Teacher_____

Unit_____

Student post-test results will be grouped in the following manner:

Example:

Number of post-test questions given 15 .

Number of students	Number of questions answered correctly.
6	12
5	10
8	9

Number of post-test questions given._____

Number of Students	Number of Questions Answered Correctly

Number of post-test questions given._____

Number of Students	Number of Questions Answered Correctly

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Recordings of Bird Songs

Available from the St. Louis County Library. Telephone: 994-3300

The Birds' World of Song

Common Bird Songs

Field Guide to Bird Songs of East and Central North America

Song Birds of America

Available from the St. Louis Public Library. Telephone: 241-2288

Bird Song In Literature

Bird Songs of Dooryard, Field and Forest: Western Birds

Common Bird Songs

Wild Bird Songs

Miscellaneous

Teacher's Forest Fire Prevention and Conservation Kit (for Grades 1-4). Forest Service, U.S. Department of Agriculture and your State Forestry Department, Eastern Region, 633 West Wisconsin Avenue, Milwaukee, Wisconsin 53203. (Free to teachers).

16MM Sound Films

Available from the Missouri Department of Conservation, Film Dept., Jefferson City, MO 65101. Please give 30 days' notice if at all possible. Cost of shipping to the school is free. Return postage must be paid by the school.

Common Animals of the Woods

Junior Raindrop

Little Smoky

Snakes: Friends and Foes

Way of Life